Section 39 Asphalt Concrete

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4-3901 General

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General

Producing a specified asphalt concrete pavement is complex, normally requiring various Caltrans employees working as a team to accomplish the desired result. The resident engineer must clearly communicate assignments of responsibility (and commensurate authority) for all personnel and also ensure adequate communication among personnel at the job site and personnel at the plant.

At the mixing plant, plant inspection specialists and acceptance testers who are not directly assigned to the resident engineer usually perform inspection and testing duties. However, the resident engineer is as responsible for enforcing the specifications at the plant as at the job site. Thus, the resident engineer must ensure contract compliance at the mixing plant as well as on-site. Good communication is essential between plant inspection specialists and assistant resident engineers. The resident engineer must be kept informed of test results in a timely manner.

The *Quality Control and Quality Assurance Manual for Asphalt Concrete Production and Placement* covers quality control quality assurance (QCQA) projects. Before these projects begin, the resident engineer should contact the district or the headquarters QCQA coordinator.

4-3902 Before Work Begins

4-3902
Before Work Begins

The following guidelines apply to non-QCQA projects. (For QCQA projects, refer to the *Quality Control and Quality Assurance Manual for Asphalt Concrete Production and Placement.*)

4-3902A General

Perform the following before work begins:

- Verify the receipt and proper distribution of Form CEM-3101, "Notice of Materials to Be Used," which covers materials to be used for asphalt concrete paving.
- Determine if the contractor intends to use an optional tapered notched wedge device to install a tapered longitudinal joint between traffic lanes. (Refer to Sheet P70 of the *Standard Plans* for the use requirements).
- Contact the Office of Materials Engineering and Testing Services (METS) for technical support if the tapered notched wedge device is used.
- To determine the required type of asphalt concrete or asphalt concrete base, review the plans, special provisions, and *Standard Specifications*. Pay particular attention to any special requirements and to the type of asphalt binder specified.
- Decide whether field conditions (such as climate or types or sources of material) require any changes in the specified materials. In making such decisions, consider issues such as the designer's intent as well as items such as preliminary test reports or previous experience with local sources.

- For information on the uses of various asphalts and the design and production of asphalt concrete, refer to *Principles of Construction of Hot-Mix Asphalt Pavements*, published by the Asphalt Institute. Personnel responsible for asphalt concrete must familiarize themselves with the information in this manual.
- If changes in the contract are necessary, determine these changes as far in advance of the operation as possible to avoid inconvenience and extra expense. Such changes must be covered by a contract change order.
- Determine whether automatic batching will be required for the contract in question. Automatic batching is required for most asphalt concrete projects and is always required for QCQA projects.
- Review the contract's measurement and payment clauses, and decide what records must be kept.
- With plant inspection staff and assistant resident engineers, review Form CEM-3501, "AC Production/Placement Checklist," and determine how often the form will be used.
- In the interest of economy, determine whether the plants from which the asphalt will be obtained are presently producing material under the same specifications for another Caltrans project. If so, decide whether you can waive initial sampling and testing. Note such a decision in the daily report, and notify the contractor in writing.

4-3902B Initial Sampling and Testing

Before work begins, take the following steps related to initial sampling and testing:

- For mix design and to determine other specified attributes, obtain samples of aggregates. The sizes of the samples are shown in the tables in Section 6-1, "Sample Types and Frequencies," of the *Construction Manual (manual)*.
- The contractor must furnish the aggregate gradation for each mix to be used on the project. Also, the contractor must furnish samples of processed aggregates, which will undergo testing to ensure compliance with specifications and to permit completion of the mix design. If the contractor changes the source of aggregate, new samples, gradings, and proportions must be furnished. When asphalt concrete will be produced from established sources, the resident engineer may allow the contractor to use the same source, gradings, and proportions as those approved for, and used on, another project. In this case samples are not required.
- Ship the samples to the district materials laboratory, where they will be processed according to the instructions you must include on Form TL-0101, "Sample Identification Card." Your objective is to ensure the laboratory specifies the asphalt content percent that will be maintained during asphalt production.
- When you propose to use an asphalt binder other than the one specified, advise the district materials laboratory so that the laboratory will base the design on the binder to be used.

4-3902C Design of Mixes

Before work begins, take the following steps related to the design of mixes:

- The district materials laboratory designs asphalt concrete mixes based on initial samples. As the sampler, you must advise laboratory personnel (usually through

your notes on Form TL-101, "Sample Identification Card") of exactly what a sample must undergo. In addition, your notes will help to inform construction personnel what the laboratory did to evaluate an initial mix design for the asphalt concrete.

- Without specific instructions, the district materials laboratory will design a mix based on a smooth grading curve located near the center of the grading envelope. In completing the mix design, request the laboratory to use the combined grading furnished by the contractor.
- For details about mix design, refer to *Principles of Construction of Hot-Mix Asphalt Pavements*.

4-3902D Plant Operations

Before production, check the following specified attributes of the asphalt plant:

- Ensure that storage meets specifications by observing the aggregate storage areas and facilities. When specifications require that the various aggregate sizes be stored separately, require physical separation, either by space between stockpiles or by some type of wall that will provide positive separation.
- Determine whether the stockpiled aggregate is similar to material upon which the design was based.
- Check that weighing equipment on the plant meets specifications. Ensure scales and meters are sealed or tested as required. For additional details, see Section 3-90E, "Weighing and Metering Procedures," in this manual. Particularly note the responsibilities of assistant resident engineers (plant inspectors) and the district weights and measures coordinator.
- The district materials laboratory must test and, if appropriate, approve all scales, interlocks, and meters in accordance with California Test 109, "Test for Weighing and Measuring Devices."
- Determine whether the plant has a temperature-sensing device on the drier. The temperature-sensing device will be a recording pyrometer. Temperatures are recorded on paper in graph form or as electronic data.
- The sensing element of the temperature-sensing device should protrude into the main stream of aggregate or the completed mix in the continuous mixing plants. The device should be located where it is not affected by wind, heat reflected from the burner, or other sources of heat.
- To check the accuracy of the temperature-sensing device, insert the device, along with an accurate thermometer, in an asphalt bath that is heated slowly above the temperature range expected of the dried aggregate. Compare the readings of the two instruments. The two readings should match very closely if the temperature-sensing device is to work within the specified tolerance under less than ideal conditions.
- The district weights and measures coordinator will have a standardized thermometer. Check the plant inspector's thermometer against the standardized one.
- Ensure the plant has a functional dust-collection system.
- When the plant uses supplemental fine aggregate or dust collected in baghouses, ensure the plant can store and proportion such material in the specified manner.

- Ensure provisions exist for safely obtaining representative bin samples of the aggregates, including a means to lower the samples from the sample deck.
- Ensure the asphalt storage tanks are calibrated to meet specifications.
- Ensure asphalt binder is stored in a way that prevents different grades of asphalt from intermingling.
- To maintain the asphalt at the required temperature, ensure all storage tanks, transfer lines, and pumps have heating coils or are jacketed and heated.
- As specified, ensure a sampling outlet valve is installed in the feed line (not in the return line). The valve should be insulated and heated, if necessary, to prevent plugging the valve with cold asphalt.
- Ensure the required asphalt temperature-sensing device is installed in the asphalt feed line as specified.
- Determine if the batch plants have the following additional specified attributes:

  1. Provisions for the binder to be introduced uniformly at the specified location.
  2. A timing device that indicates by an audible or visual signal the end of the mixing period. Ensure the system is in working order and accurate to the specified degree.

- Ask the district weights and measures coordinator or plant specialist for a detailed preproduction inspection and calibration of continuous mix and batch asphalt concrete plants.
- Based on initial samples and tests, provide the contractor with the amount of asphalt binder to be used.

4-3902E Street Operations

Before work begins, take the following steps related to street operations:

- Review "Placing Hot-Mix Asphalt" in the *Principles of Construction of Hot-Mix Asphalt Pavements manual*. This manual covers the many aspects of good paving practice.
- Ensure that subgrade has been prepared as specified. Decide whether asphalt concrete is to be spread over an existing surface to level irregularities. Advise the contractor if leveling is required and also of the method of payment.
- Discuss with the contractor the tack coat that must be used, including the number of applications, the exact application rate, and how far in advance of the surfacing operation the coat may be placed as designated in the contract special provisions. Refer to the *Tack Coat Guidelines* for complete instructions on the applications for all surfaces. The guidelines are available at the following address:

  http://www.dot.ca.gov/hq/construc/

- Consider atmospheric conditions in selecting the tack coat material to be applied. Refer to the discussions of and tack coat in "Placing Hot-Mix Asphalt" in *Principles of Construction of Hot-Mix Asphalt Pavements*.

- Ensure asphalt distributor trucks have the specified attributes. For tack coat placement guidelines, see Section 4-92, "Asphalts," Section 4-93, "Liquid Asphalts," and Section 4-94, "Asphaltic Emulsions," of this manual.
- Ensure the spreading equipment has the specified attributes. Pay particular attention to pavers that are variable in width, to ensure that spreading and compacting components (roller, tamper, or other suitable devices) extend for the full width of the traffic lane to be paved. Permit wings, or other spreading devices, only for areas not requiring an asphalt paver, and then only for such widths (usually less than 1.5 m) as will not adversely affect the surfacing on the traffic lane.
- Ensure rollers have the specified attributes. Ensure the specified number of rollers will be used, unless other compaction requirements are noted in the special provisions.
- If the contractor intends to use equipment other than the specified rollers to compact asphalt concrete, contact the district construction office to determine whether this equipment has been evaluated in accordance with California Test 113, "Evaluating the Capabilities of Asphalt Concrete Compactors." The district construction office maintains a listing of all compaction equipment that has been evaluated in accordance with the test. The Division of Construction notifies each district construction office of changes or additions. The listing also includes the operating conditions under which the equipment qualified. The contractor may use qualified equipment in the work without further testing provided the contractor adheres to the operating conditions set forth. If the proposed equipment is not listed, request the flexible pavement unit of the Office of Materials Engineering and Testing Services (METS) to evaluate the equipment.
- When compaction specifications for asphalt concrete are in effect, ensure that properly calibrated nuclear density gauges are available for the necessary compaction tests.
- Determine the atmospheric temperature, and prohibit the placing of asphalt concrete when applicable temperatures are below the minimum. Before placement, closely monitor local weather forecasts and conditions. Even a light drizzle can adversely affect the final product.
- For procedures to follow when resurfacing under structures that will result in reduced clearances, refer to Section 3-705B, "Clearance and Bridge Permit Rating Changes (Permanent)," of this manual.
- Before they take mat samples, ensure field engineers involved in asphalt concrete paving are certified through California Test 125, "Methods for Sampling Highway Materials and Products Used in the Roadway Structural Sections."

4-3903 During the Course of Work

4-3903 During the Course of Work

The following guidelines apply to non-QCQA projects. (For QCQA projects, refer to the *Quality Control and Quality Assurance Manual for Asphalt Concrete Production.*)

4-3903A Plant Operations

During the course of work, take the following steps related to plant operations:

- For the asphalt concrete plant, maintain a daily record with the information

required in Section 39, "Asphalt Concrete," of the *Standard Specifications*. File a copy of this information under Category 35, "Asphalt Concrete," in the project records.

- Ensure that production rates in continuous mix plants do not exceed those rates established during the aggregate weigh belt and asphalt meter calibration (California Test 109).
- Ensure that the proportioning equipment is interlocked as specified. For details on checking the interlock, refer to Section 4-9003A, "Proportioning and Mixing Operations," of this manual. This procedure is the same for asphalt concrete plants as it is for portland cement concrete plants.
- Observe the overall plant operation to ensure the contractor controls dust or smoke as specified. Request the contractor to correct any obvious violation and to cease any operation that is causing damage to adjacent property or to the asphalt concrete mixture.
- For each truckload of paving asphalt or liquid asphalt, obtain the required test report. Compare the report with the specifications. Shipments may be used before Caltrans samples and tests them if certificates of compliance accompany the shipments.
- Obtain a sample of asphalt binder and ship it to METS for testing as detailed in Section 6-2, "Acceptance of Manufactured Material and Sampling Methods," of this manual.
- Ensure aggregate is stored separately, according to the specified sizes. If any segregation, degradation, or intermingling occurs, require the contractor to empty the storage facility and to waste or rescreen the material.
- Ensure supplemental fine aggregate remains dry and is stored separately as specified.
- Before mixing with asphalt, obtain samples of the aggregate in accordance with the frequency shown in Section 6-1, "Sample Types and Frequencies," of this manual. Do not use aggregate samplers that do not safely produce a manageable-sized sample.
- When grading test or sand equivalent results exceed the limits for contract compliance, determine whether the asphalt concrete represented by the test is to remain in place or be removed. Note the decision in the daily report.
- Keep adequate records for removed material or material that remains in place but exceeds the grading limits for contract compliance. Do not make payment for material removed from the work. Also, ensure the specified deduction is taken for material that is allowed to remain in place even though it exceeds the grading limits for contract compliance.
- Ensure the temperature of the asphalt binder, aggregate, and completed mix are within the specified ranges.
- Ensure the batch size and feed rates do not exceed the mixing capacity.
- After calculating and selecting batch weights for batch-type asphalt concrete plants, inspect scale settings. Follow this inspection with daily checks. The scale settings control the amount of material from each bin; one erroneous scale setting can throw the entire batch out of specification.

- To ensure the aggregate is stored in the specified sizes, compare the material from each bin with the specifications. Order any necessary corrective action.
- Compare the gradings by plotting the actual grading curve against the design curve. Plot the gradings periodically because plotting provides a better indication than numbers alone.
- The contractor may adjust the proportions of primary sizes of aggregates. However, any such adjustment must meet specified grading limits and should result in a stable mix. When adjustments vary significantly from the initial design's grading, request a new asphalt content calculation from the district materials laboratory based on the grading to be used.
- Sample and test aggregate and asphalt binder in accordance with the frequencies shown in Section 6-1, of this manual.
- Obtain samples of the completed mix, and in accordance with California tests 310, "Determination of Asphalt and Moisture Contents of Bituminous Mixtures," or 370, "Determining Moisture Content of Asphalt Mixtures or Mineral Aggregates," for moisture. You may also quickly check moisture content (based on your experience with a particular aggregate source) using the following method for batch plants:

  1. Take a shovelful of aggregate from the drier's discharge chute.
  2. Notice any steaming or dark spots on the aggregate.
  3. Pass a cool, shiny, clean mirror, spatula, knife or other similar item in a slow deliberate motion immediately above the aggregate.
  4. Observe the amount of condensed moisture on the item.
  5. Advise the contractor of any necessary adjustments to dry the aggregate.

- Perform California Tests 310 or 370 "as necessary for control." For the exact frequency of the tests, refer to Section 6-1, "Sample Types and Frequencies," of this manual. Early in production, take sufficient tests to determine factors such as the drier's heat versus the production rate versus the aggregate's moisture.
- Observe production at the batch plant to ensure the mixing time and sequence of withdrawal from the bins produce the specified homogeneous mixture. For batch mixing, do not approve a shorter mixing time than specified. The length of mixing time in a continuous-flow mixer is a function of the length of the mixing area and the rate of drop in the drier drum mixing. The most efficient pugmill mixing results when the material level remains at the top of the paddles throughout the length of the mixer. For best results, feeding must be continuous and uniform.
- Ensure that the temperature of the asphalt stays within the specified limits.
- When the contractor uses automatic batch mixing, ensure the automatic equipment functions within specifications.
- When the contractor uses any continuous mixing plant (drier drum or drier drum pugmill), ensure that the vibrating unit on the fine bins operates. Also, ensure that the low-level and no-flow interlock systems for the aggregate feeder bins and the asphalt storage function.

- Observe the operation of all weighing systems. Whenever scales and meters seem inaccurate, contact the district weights and measures coordinator for further assistance.
- In the batching process, consider the weight of the material falling from the bin gates to the weighing hopper after the gates are closed. Ensure the weigh box containing the total batch does not come in contact with anything that prevents a true indication of the batch weight.
- When intermediate storage does not occur, periodically check the batching by comparing the total weight of the batches in a truckload with the platform scale weight for the same load.
- Check the asphalt scales frequently to ensure the following:
  1. They can mark zero.
  2. The scale levers and knife edges move freely.
  3. No bind or drag exists on the lever system.
- When plants are used exclusively for one job, you can check the accuracy of meter-driven devices that proportion asphalt. To do so, compare meter totalizer readings with asphalt tank stabbings and also (in conjunction with an onsite vehicle scale) with the combined aggregate totalizer readings.
- Some plants are equipped with storage silos for asphalt concrete. Ensure this form of storage does the following:
  1. Prevents obvious segregation
  2. Maintains specified temperatures
  3. Maintains the minimum silo level as specified
  4. Does not exceed the maximum storage time
- Before the contractor loads the truck beds, ensure the absence of an excessive amount of parting agent or other contaminating material. Such material is excessive when it forms pools absorbed by the mix. Diesel or other petroleum-based products are prohibited.
- Ensure that all continuous mixing plants have a functional automatic blending computer. Prohibit the plant from producing material for Caltrans unless this automatic aggregate-asphalt proportioning system operates in good working condition.

4-3903B Street Operations

During the course of work, take the following steps related to street operations:

- For guidelines for inspecting prime coat and tack coat, refer to Sections 4-93, “Liquid Asphalts,” and Section 4-94, “Asphaltic Emulsions,” of this manual.
- From the mat behind the paving machine, obtain a sample of the completed mixture (using California Test 125, “Methods for Sampling Highway Materials and Products Used in Roadway Structural Sections”). Test the sample for extraction, moisture, and sieve analysis. Occasionally run stability tests. For the frequency and location of such testing, refer to Section 6-1, “Sample Types and Frequencies,” of this manual.

- Identify the samples to indicate both the stationing from which they were taken and also the approximate area they represent. Mark all acceptance samples for priority testing. Complete Form TL-0101, "Sample Identification Card," adhering to the instructions printed in the book containing the forms and information in Section 6-105, "Field Tested Material Sample Identification," of this manual. It is essential that you record the type of mix, grade, and source of asphalt and also the ordered percent of asphalt in the mixture. Remember to note whether the sample is for acceptance or special testing.
- As early as possible, analyze the test data. The best results come from obtaining test results on the day of sampling. If possible, samples representing drier-drum or continuous mixing should be tested in the field so the contractor can immediately correct any deviations.
- Ensure that placement occurs within the specified temperature range by taking sufficient measurements of air and asphalt concrete temperatures. Record these temperatures in the daily report, and on Form CEM-3501, "AC Production/ Placement Checklist."
- Along with atmospheric conditions, closely observe the queuing of asphalt concrete trucks. To prevent the cooling of the asphalt concrete mix to below the specified windrow temperature, ensure that extensive windrowing does not occur. To determine whether crusting has occurred and appropriate action should be taken, check the surface of the asphalt concrete mix in the truck or windrow.
- Ensure the specified equipment performs the spreading at the required thickness and with the required number of layers. Compare the spread rate against the theoretical rate, and if necessary, order adjustments. Note such observations in the daily report.
- Because of the high dollar value of the asphalt concrete and the necessity for an assistant resident engineer to know the weight of loads for spread calculations, load slips are required for asphalt concrete.
- For placing material, ensure the specified equipment performs the rolling in the specified order, for the required number of coverages, with the mixture's temperature above specified minimums. If the contractor uses a vibratory roller for compaction, ensure the use is in accordance with the operating conditions for which the roller was qualified. For these conditions, refer to the Vibratory Roller Qualification List. To check vibratory roller frequencies, use a vibratory reed tachometer.
- When compaction specifications are in use, test all areas in accordance with California tests 304, "Preparation of Bituminous Mixtures for Testing," and 375, "Determining the In-Place Density and Relative Compaction of AC Pavement."
- Ensure that longitudinal joints are offset as specified and that the joints on top courses correspond to the edges of traffic lanes.
- Before placing an adjacent top layer, ensure the contractor has trimmed the cold-transverse construction joints to a vertical face and to a neat line.
- Before placing an adjacent lane, decide whether longitudinal joints should be trimmed.
- Use a straightedge to determine whether the finished surface and transverse joints comply with specified tolerances. Note such measurements in the daily report.

- If using a tapered notch wedge device, ensure that the specical provisions allow the contractor to use a tapered notched wedge device to install a tapered logitudinal joint between traffic lanes.
- Ensure the contractor tests the notched wedge device for relative compaction.
- After acceptance of the contract, a compaction and core information spreadsheet must be submitted to the Office of Flexible Pavement, Material Engineering and Testing Services.
- Ensure the contractor surfaces miscellaneous areas as the plans and specifications require.
- Examine asphalt surfaces, and decide whether fog seal should be applied to shoulders. Fog seal must be applied to all asphalt concrete dikes and miscellaneous areas. For details about seal coats, refer to Section 4-37, "Bituminous Seals," of this manual.
- Prohibit the contractor from applying fog seal to open-graded asphalt concrete or any traveled way.

4-3904 Measurement and Payment

4-3904 Measurement and Payment

For details of measurement and payment, review contract specifications. Make necessary measurements and counts.

For measuring asphalts, liquid asphalts, and asphaltic emulsions, refer to Section 4-92, "Asphalts," Section 4-93, "Liquid Asphalts," and Section 4-94, "Asphaltic Emulsions," of this manual.

For asphalt concrete that is allowed to remain in place, yet the aggregate gradings for this asphalt concrete do not meet contract compliance, make the appropriate deductions as specified.

For guidelines on how to weigh asphalt concrete, refer to Section 3-9, "Measurement and Payment," of this manual.